



U.S. Patent Application Serial No. 10/827,089
Filed: April 19, 2004
Inventor: James Wagner Larsen
For: Systems and Methods Useful For Detecting Presence
And/Or Location Of Various Materials
Attorney: James L. Ewing, IV
Telephone: 404.315.6494
Attorney Docket No. 14088/299978

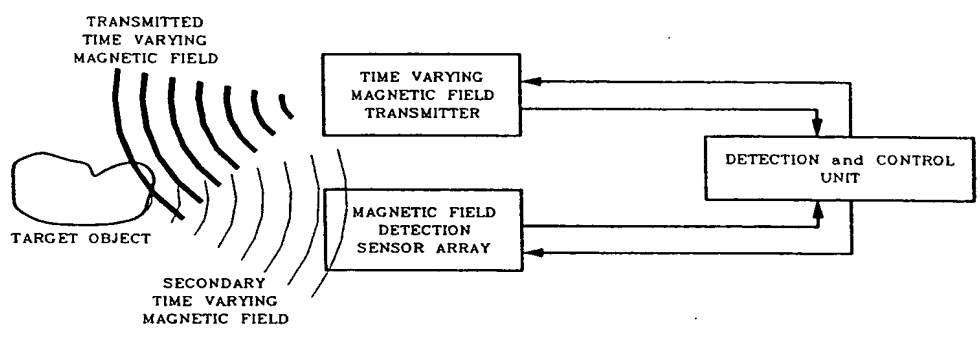


FIGURE 1-1 SYSTEM BLOCK DIAGRAM

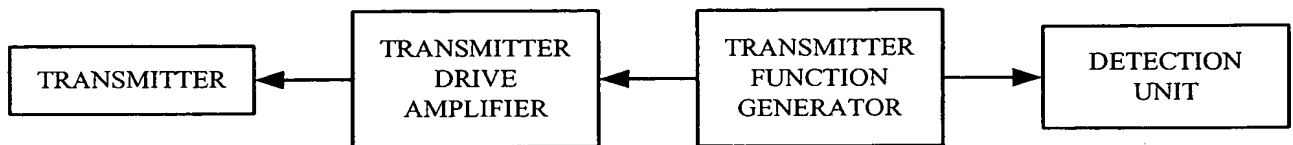


FIGURE 1-2
TRANSMITTER WITH KNOWN OUTPUT FUNCTION

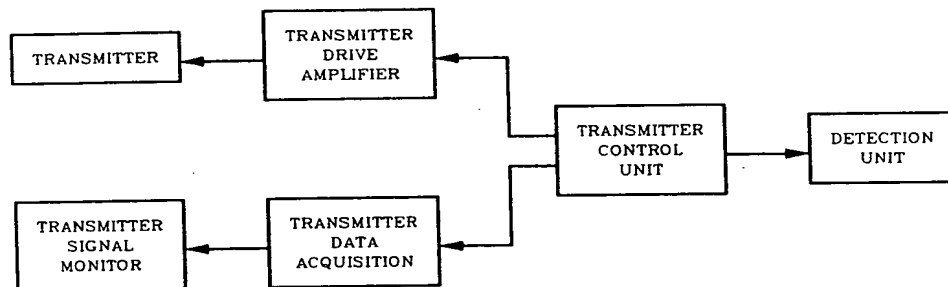


FIGURE 1-3
TRANSMITTER WITH MAGNETIC FIELD MONITOR

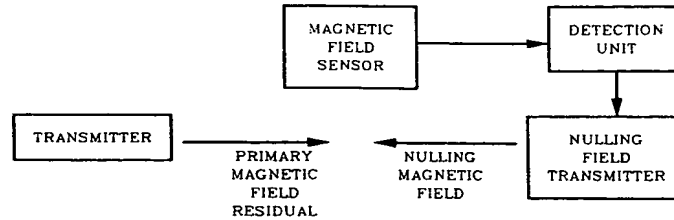


FIGURE 1-4A
 RESIDUAL MAGNETIC FIELD NULLING
 USING A NULLING MAGNETIC FIELD

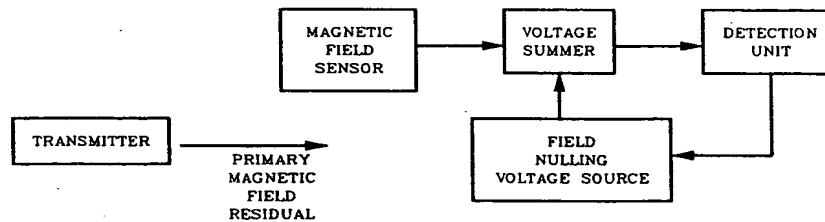


FIGURE 1-4B
 VOLTAGE NULLING OF RESIDUAL FIELD SENSOR OUTPUT

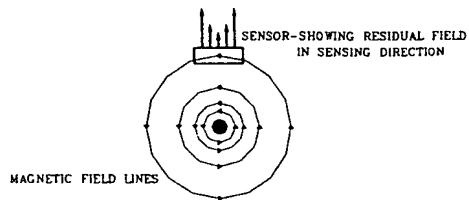


FIGURE 1-5A
 TRANSMITTER COIL CROSS SECTION FOR SINGLE WIRE COIL
 SHOWING SENSOR POSITION AND RESIDUAL FIELD

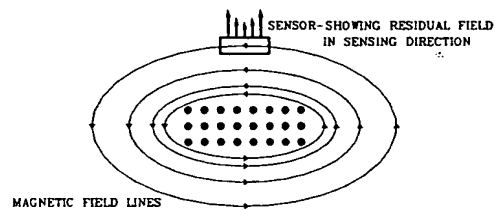


FIGURE 1-5B
 TRANSMITTER COIL CROSS SECTION FOR NORMAL RECTANGULAR COIL
 SHOWING SENSOR POSITION AND RESIDUAL FIELD

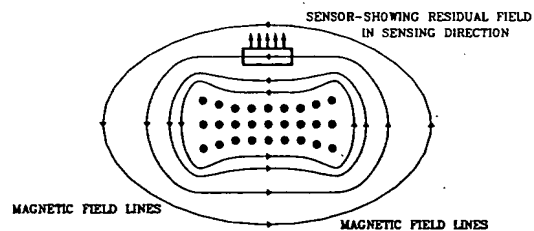


FIGURE 1-5C
 TRANSMITTER COIL CROSS SECTION FOR SHAPED COIL
 SHOWING SENSOR POSITION AND RESIDUAL FIELD

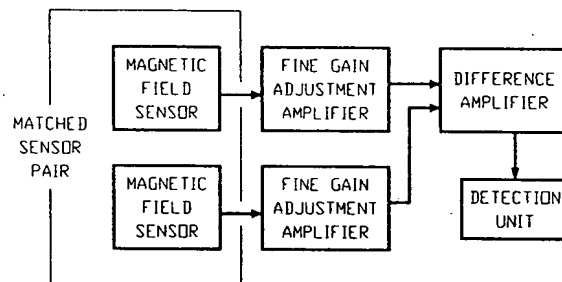


FIGURE 1-6
GRADIENT SENSING USING A MATCHED SENSOR PAIR

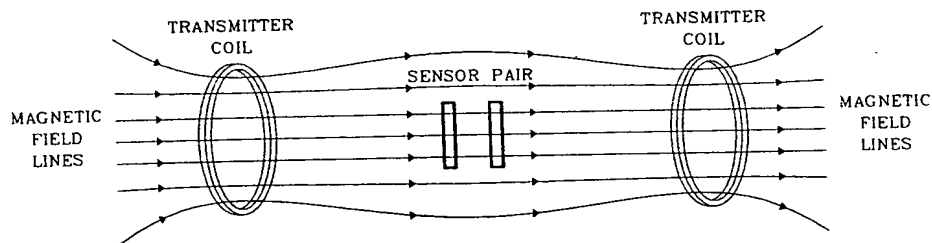


FIGURE 1-7
SENSOR PAIR CALIBRATION
USING TWO TRANSMITTER EQUAL COILS

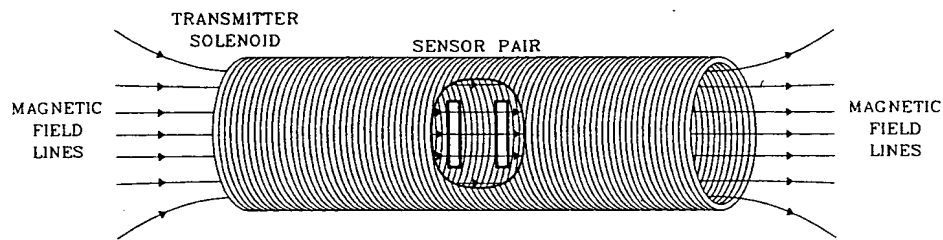


FIGURE 1-8
SENSOR PAIR CALIBRATION
USING A LARGE SOLENOID COIL

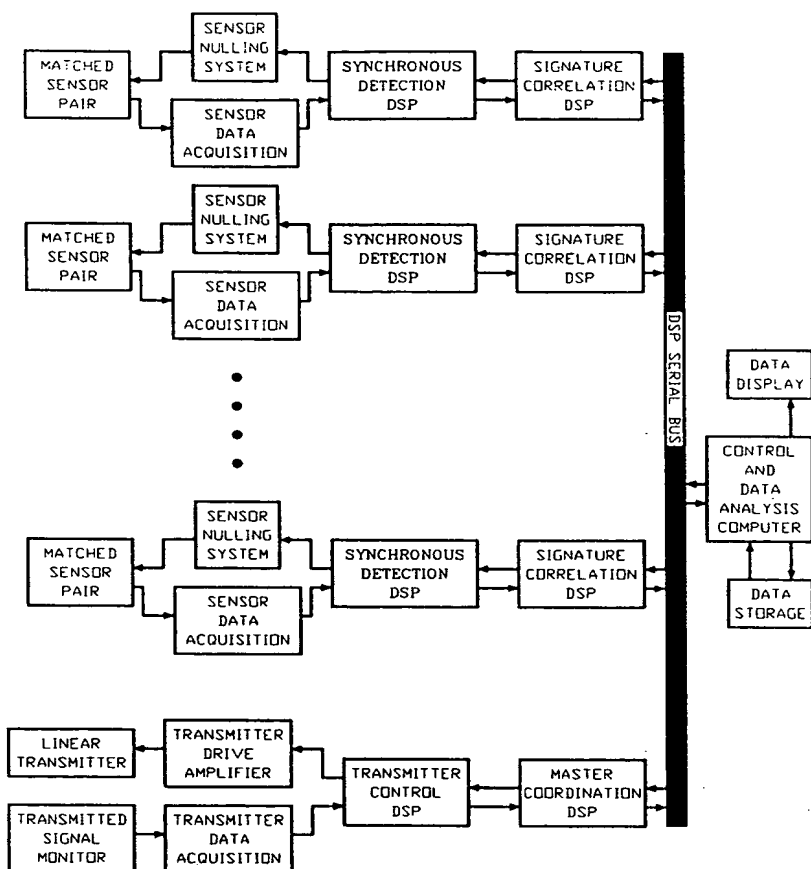


FIGURE 1-9
 SYSTEM WITH MULTIPLE SENSOR PAIRS
 AND SYNCHRONOUS DETECTION
 BASED ON DSP PROCESSORS

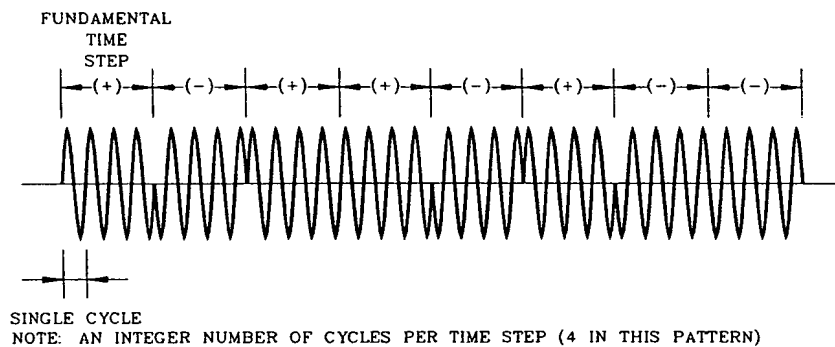


FIGURE 1-10
AN 8 SECTION (+ - + + - + - -)
TIME ENCODED WAVEFORM

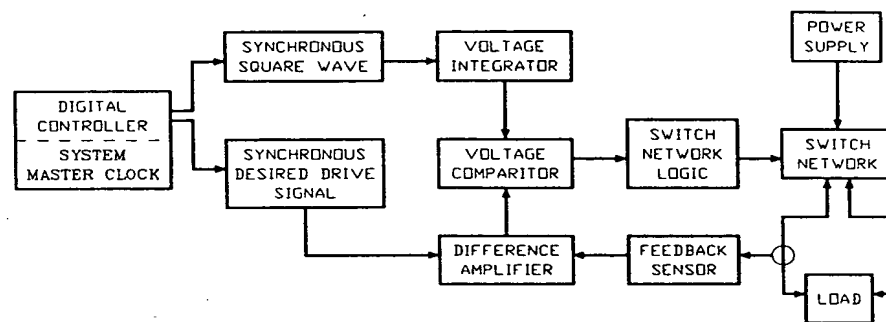


FIGURE 2-1
SYNCHRONOUS PULSE WIDTH MODULATION AMPLIFIER

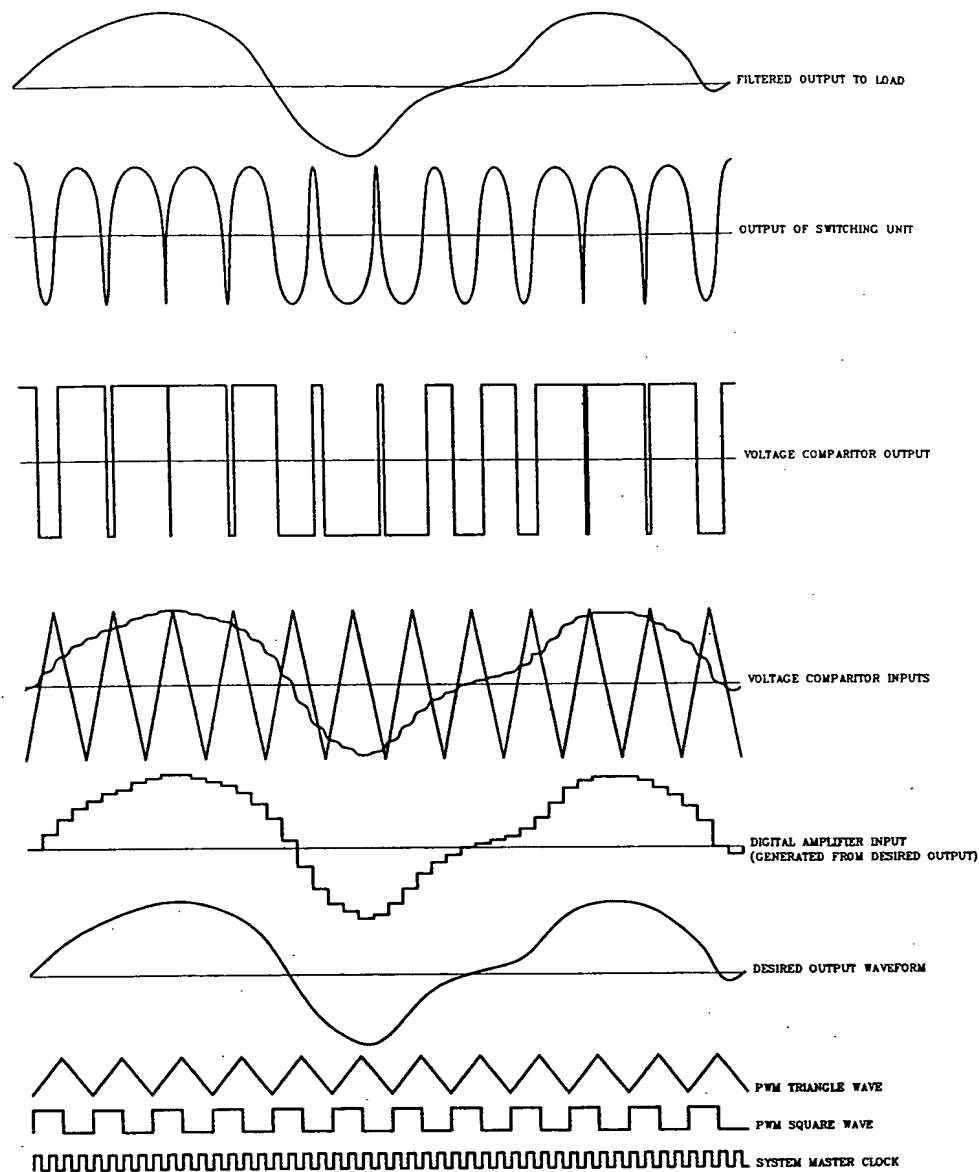


FIGURE 2-2
TYPICAL PULSE WIDTH MODULATION WAVEFORMS

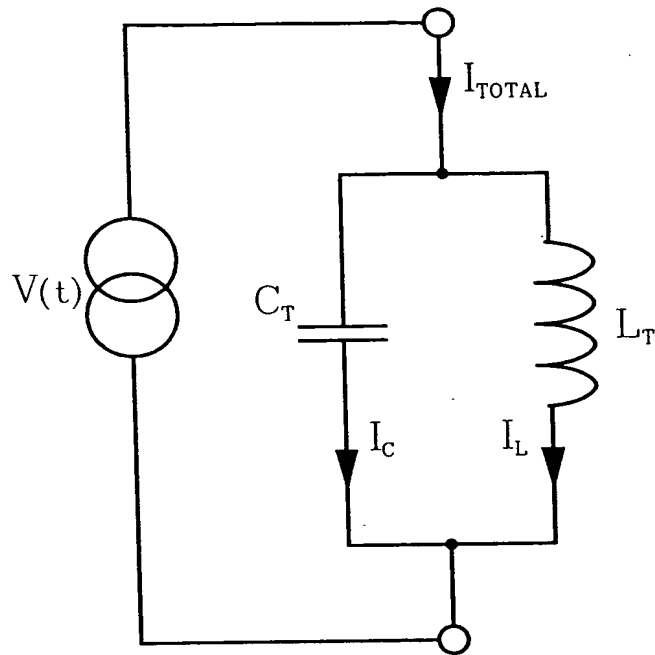


FIGURE 3-1
STANDARD TANK CIRCUIT

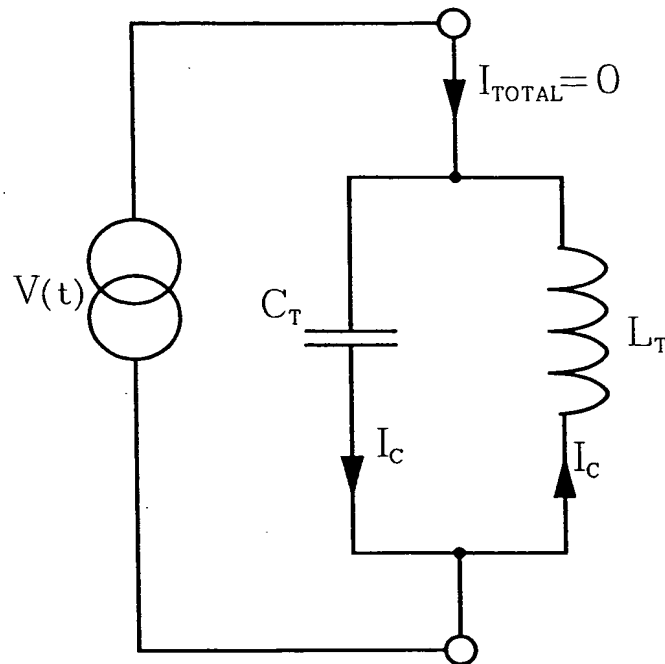


FIGURE 3-2
AT RESONANCE TOTAL CURRENT IS ZERO
BECAUSE, $I_L = -I_C$

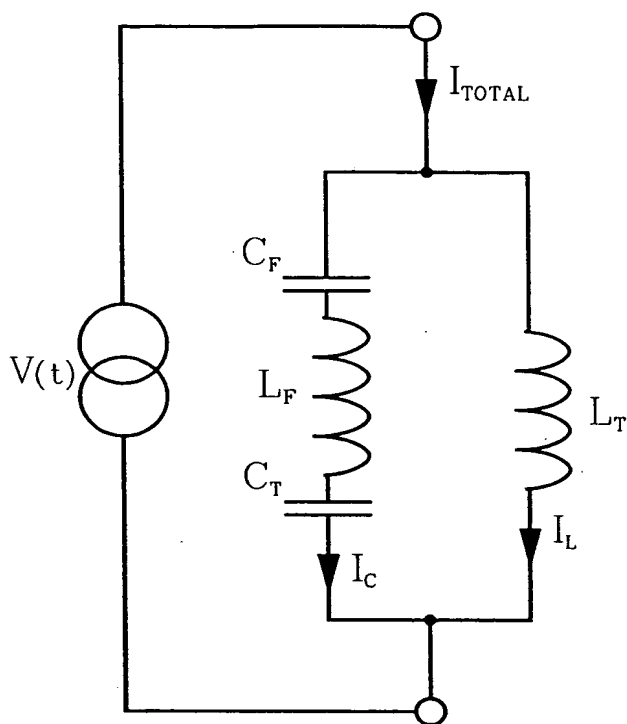


FIGURE 3-3
TANK CIRCUIT WITH SERIES CAPACITOR
AND INDUCTOR TO LIMIT OFF RESONANCE I_C

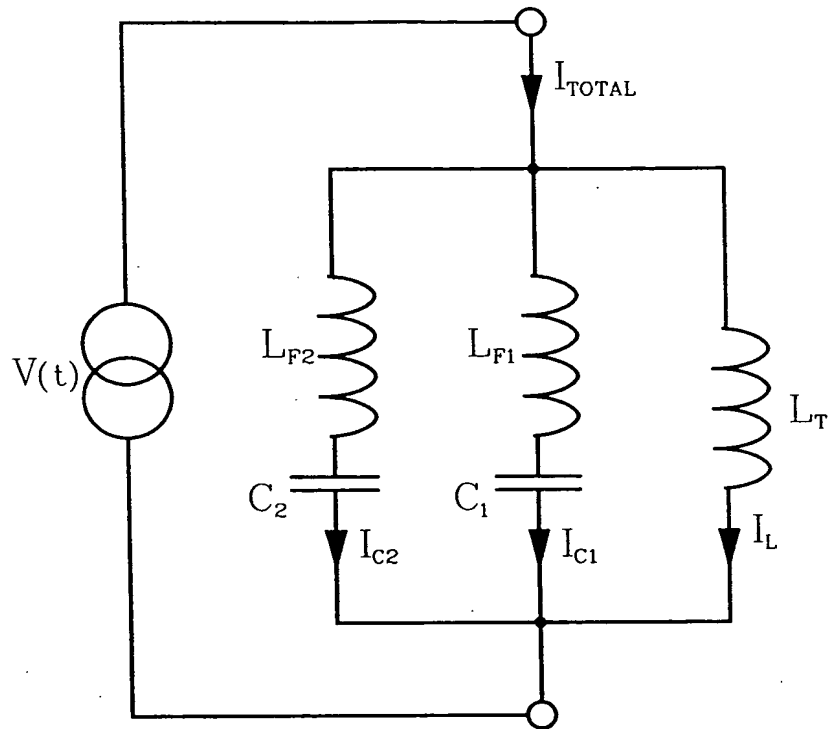


FIGURE 3-4
TANK CIRCUIT WITH TWO RESONANCES

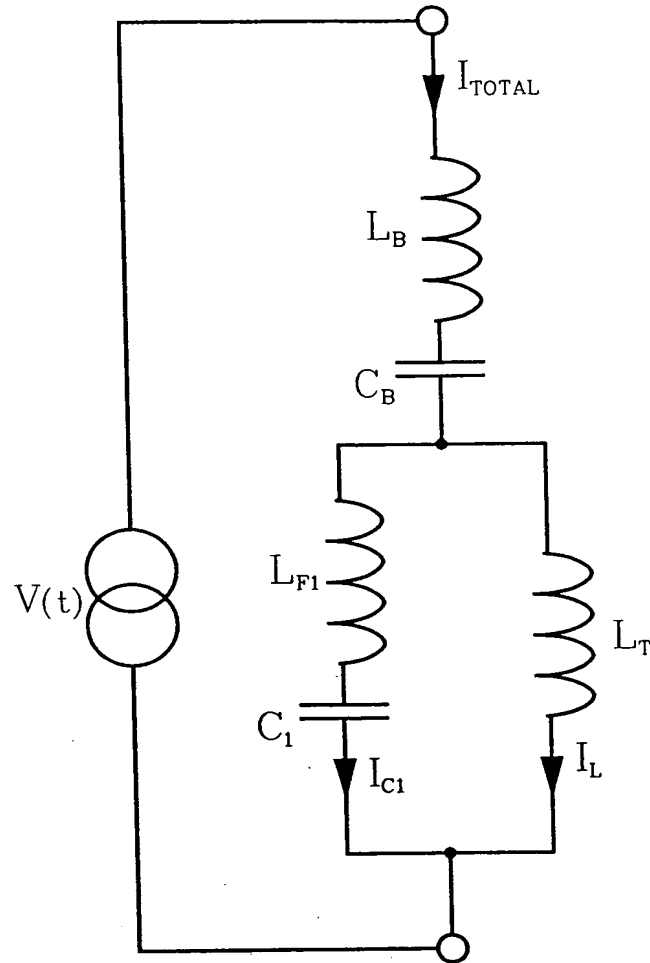


FIGURE 3-5
TANK CIRCUIT WITH
SINGLE FREQUENCY BLOCKING CIRCUIT

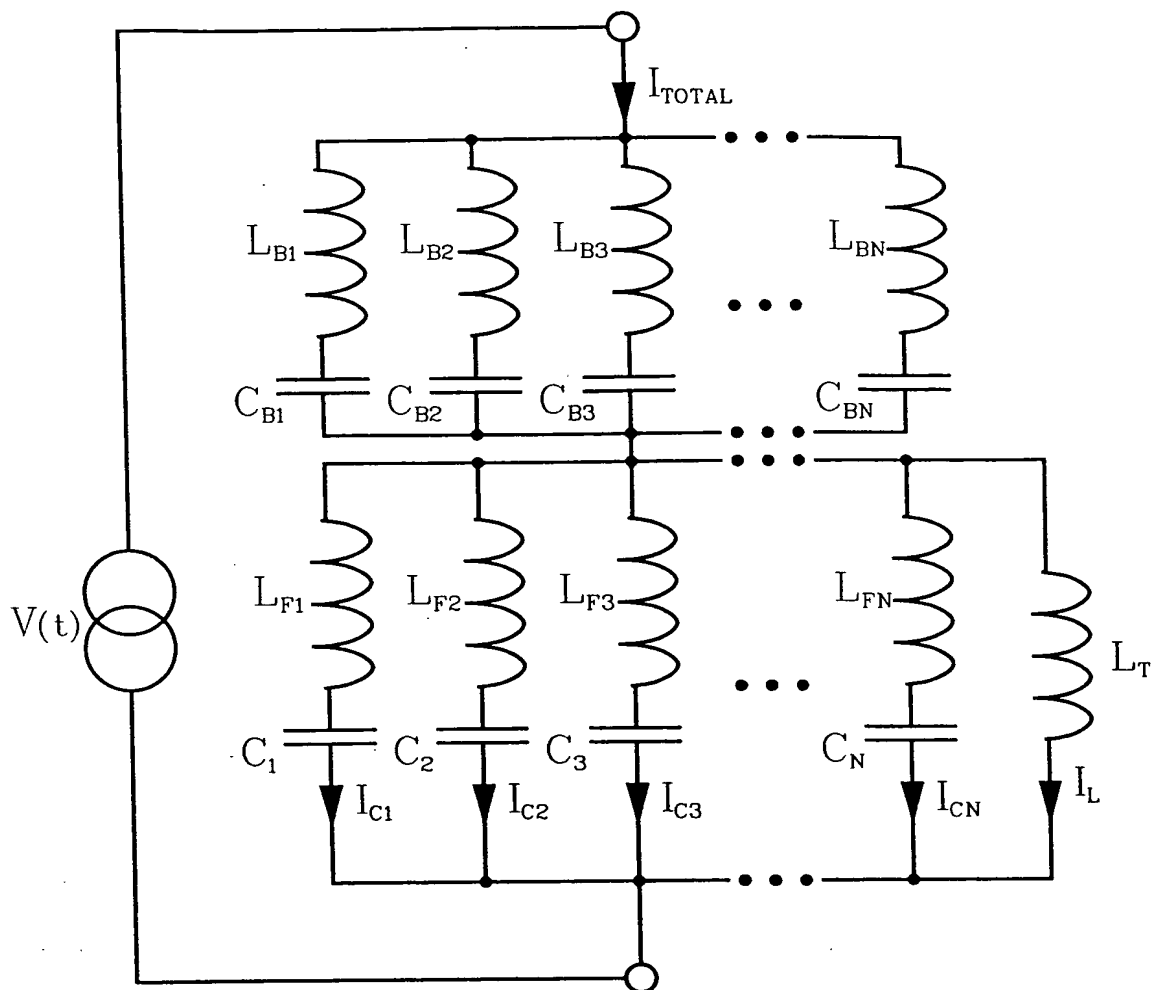


FIGURE 3-6
 TANK CIRCUIT WITH
 A MULTIPLE FREQUENCY BLOCKING CIRCUIT
 FOR N DISCRETE FREQUENCIES

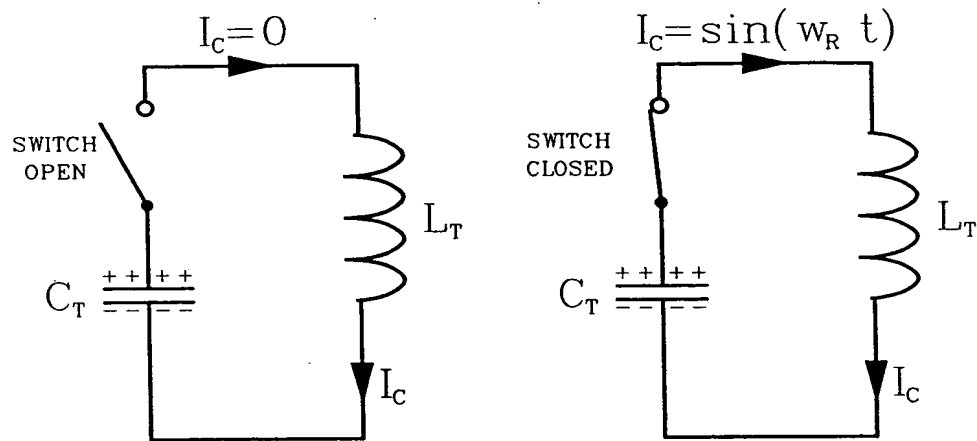


FIGURE 4-1
WHEN SWITCH IS CLOSED CIRCUIT OSCILLATES
AT RESONANT FREQUENCY, w_R

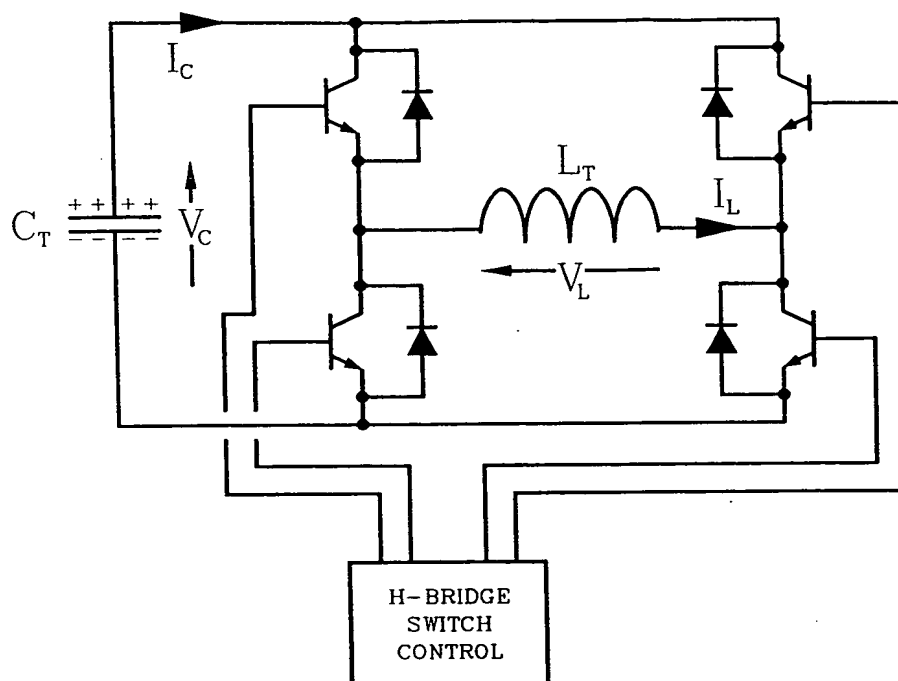


FIGURE 4-2
 AN H-BRIDGE SWITCH NETWORK
 CONNECTING THE CHARGED CAPACITOR
 TO THE LOAD COIL

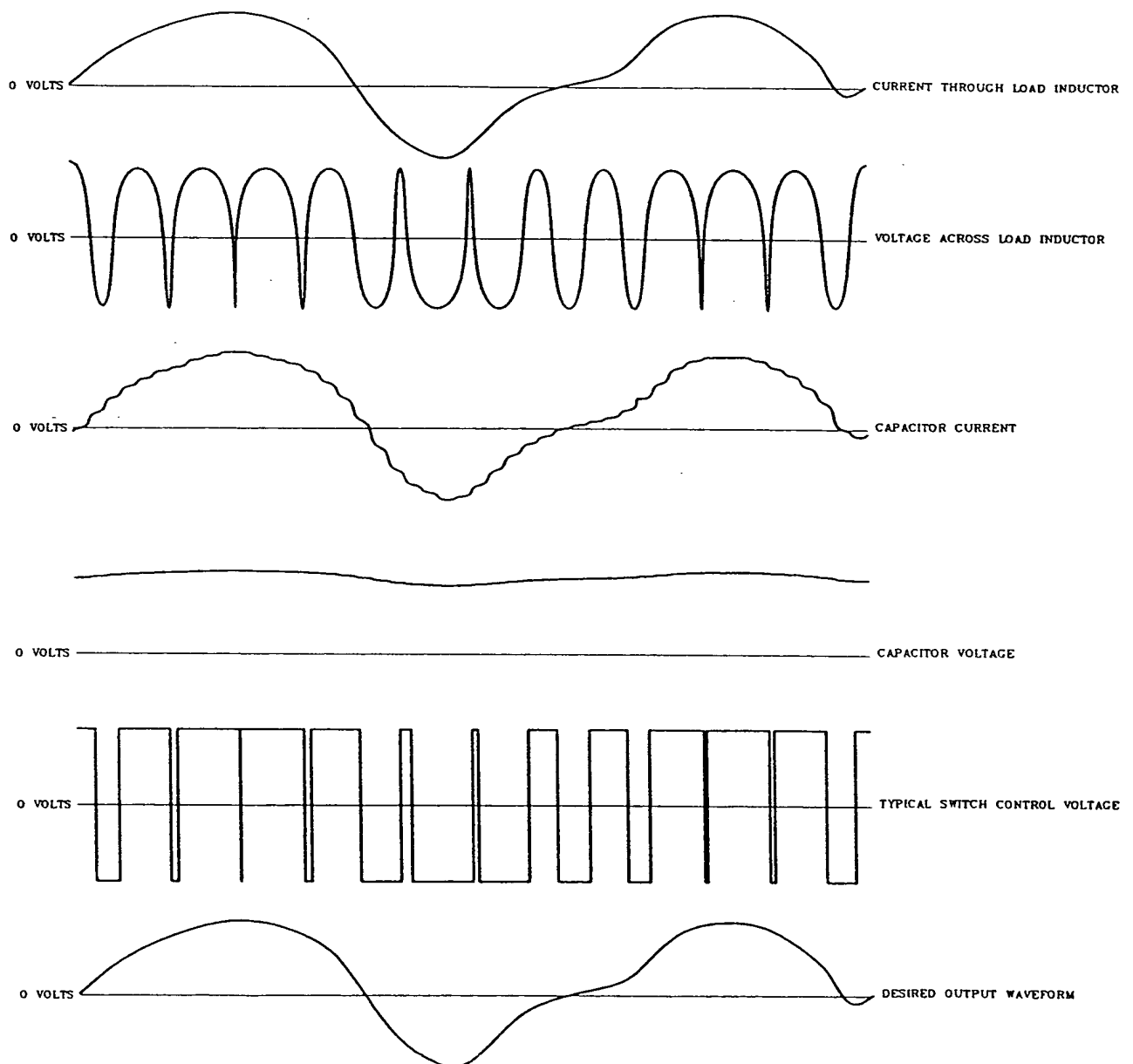


FIGURE 4-3
SWITCHED CAPACITOR CIRCUIT WAVEFORMS

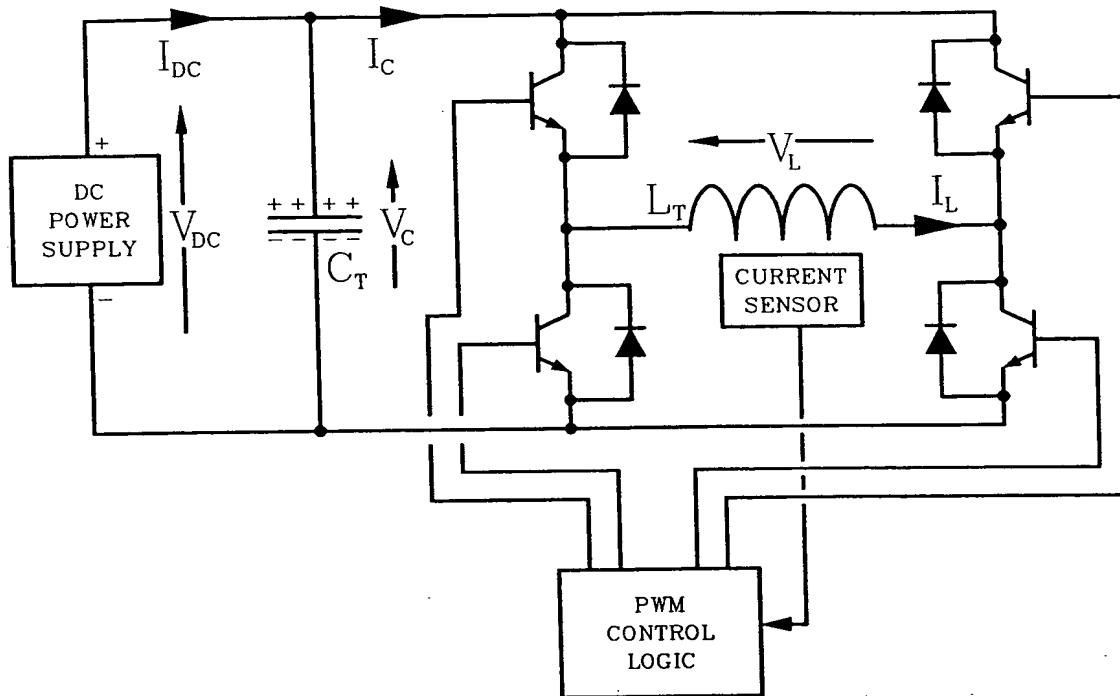


FIGURE 4-4
 PULSE WIDTH MODULATED
 SWITCHED CAPACITOR RESONATOR

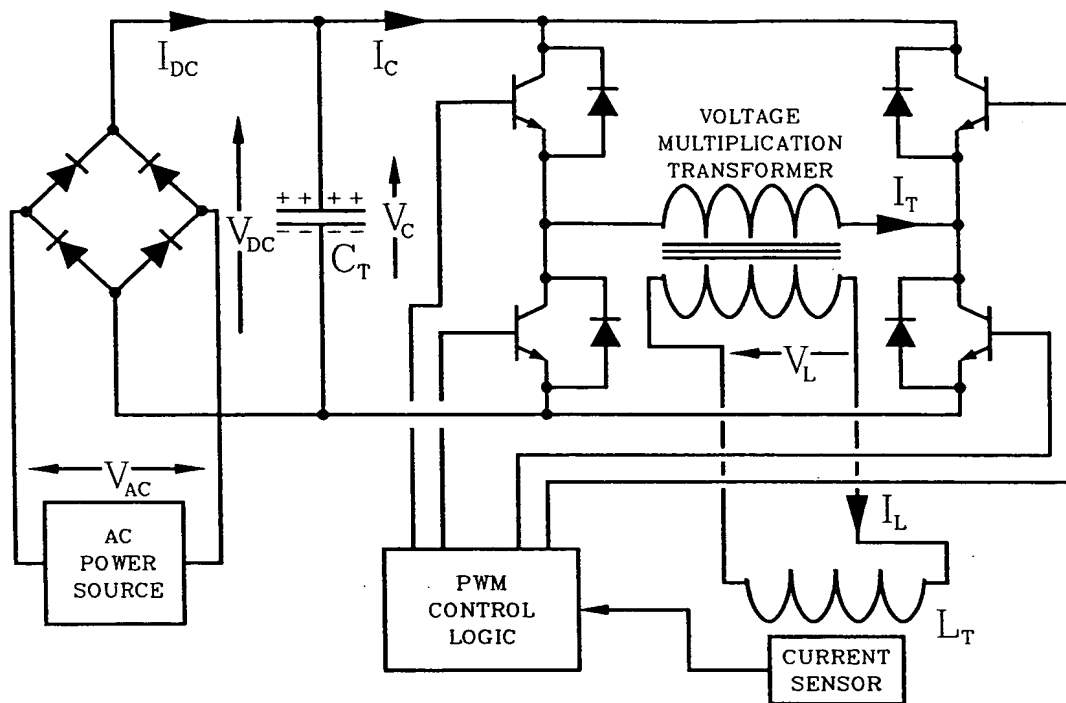


FIGURE 4-5
 SWITCHED CAPACITOR RESONATOR
 WITH INTEGRAL SWITCHING POWER SUPPLY

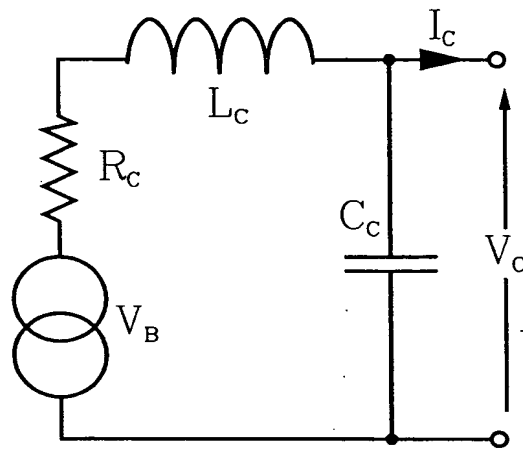


FIGURE 5-1
SENSE COIL EQUIVALENT CIRCUIT

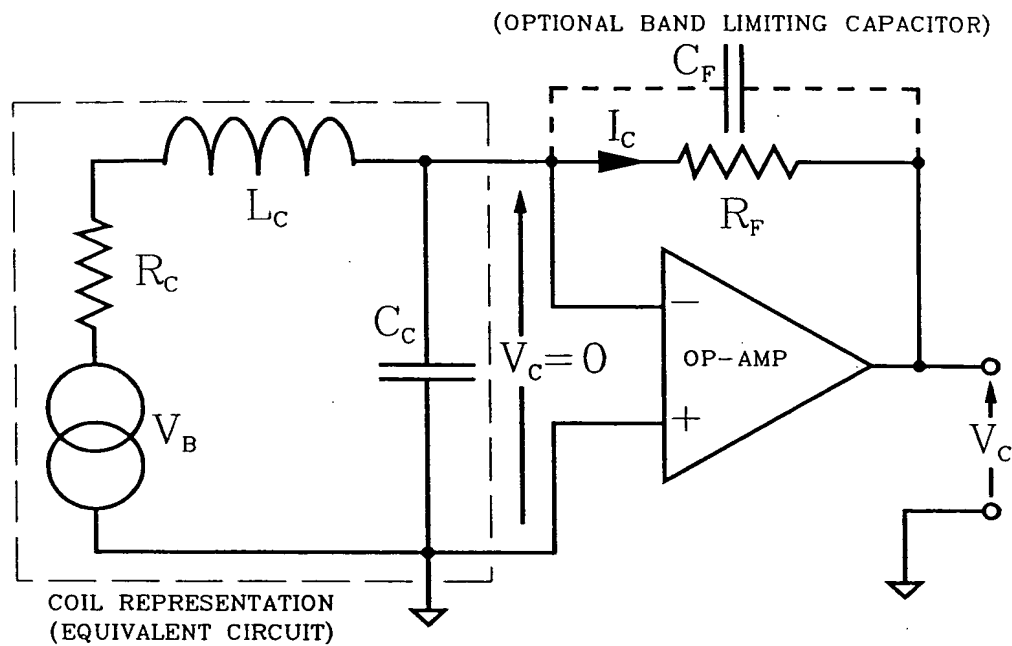


FIGURE 5-2
 OPERATIONAL AMPLIFIER BASED
 VOLTAGE TO CURRENT CONVERSION CIRCUIT

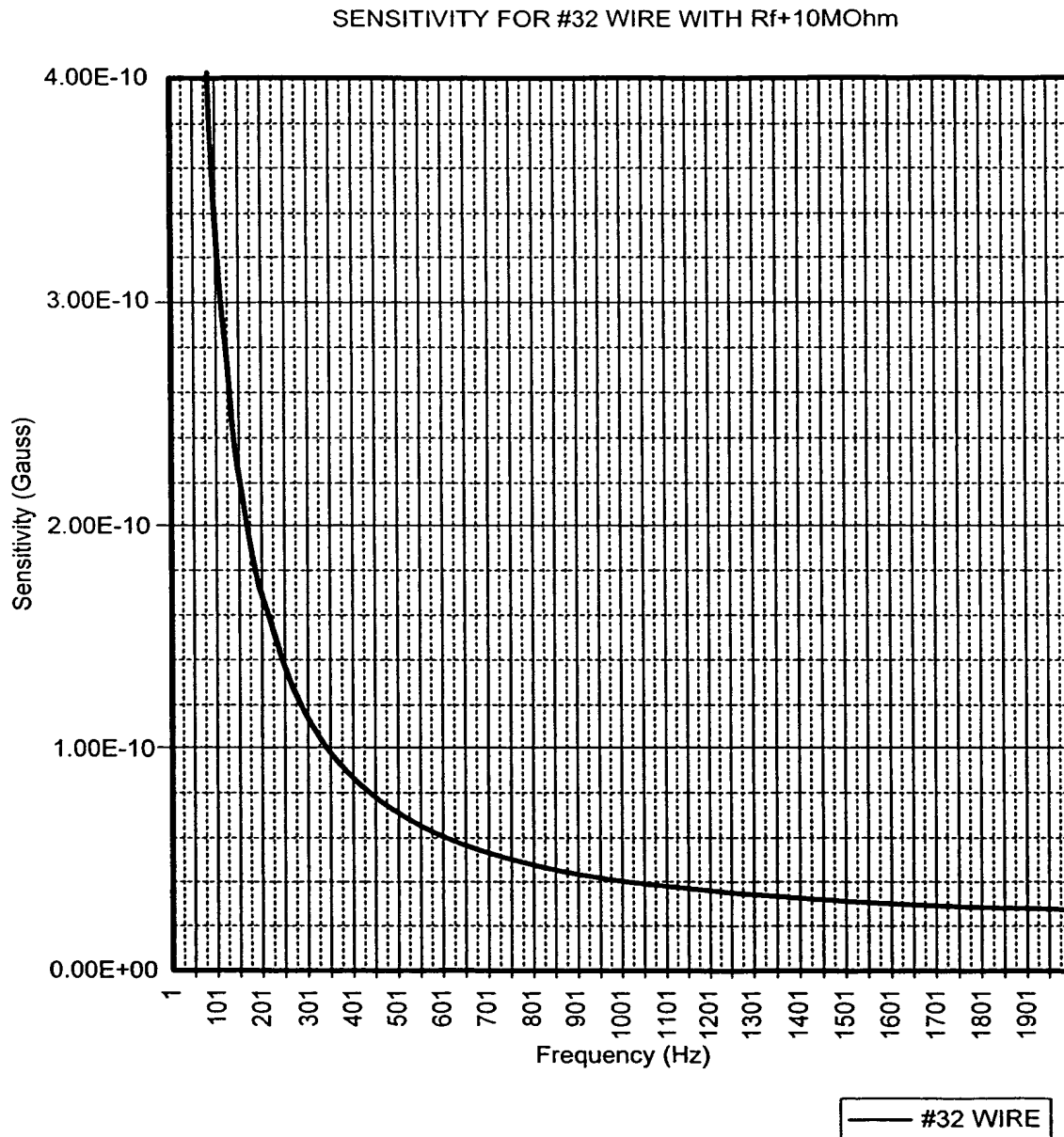


FIGURE 5-3

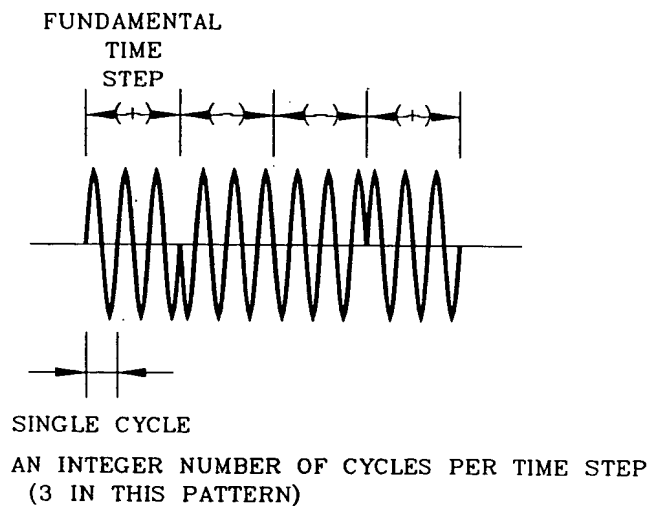
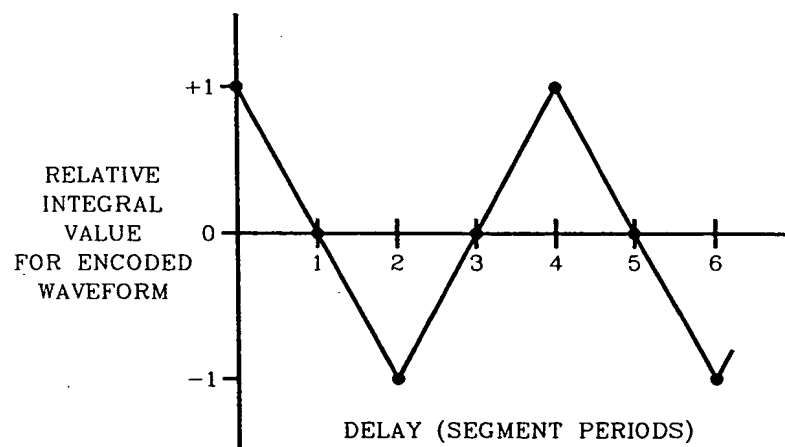
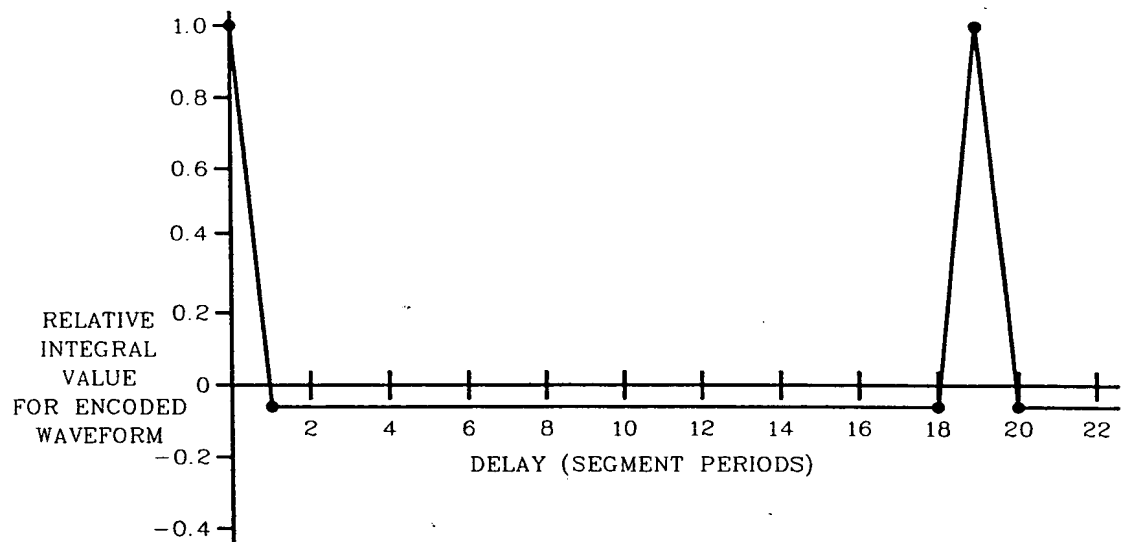


FIGURE 6-1
A 4 SEGMENT (+ - - +)
TIME ENCODED WAVEFORM



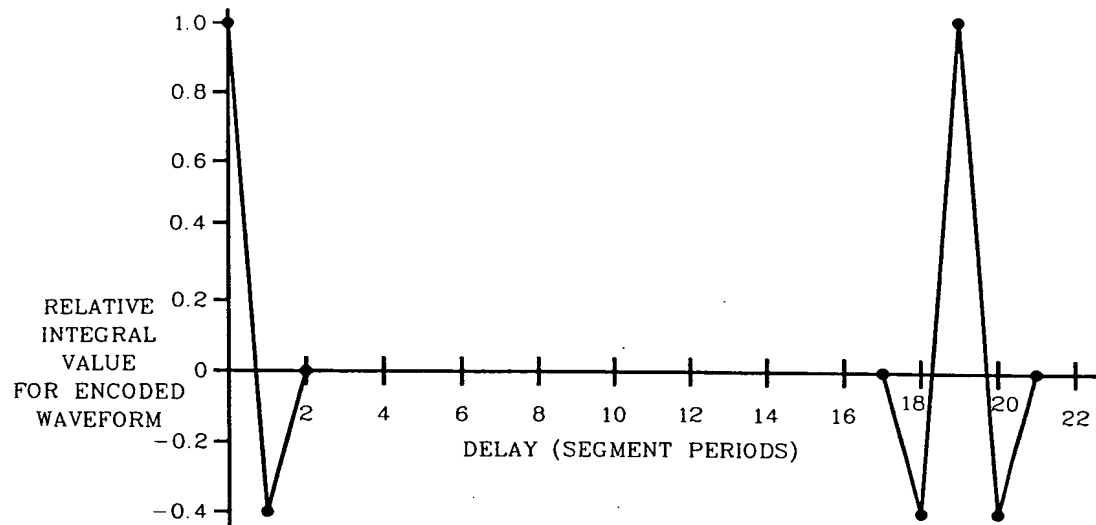
NOTE: THE INTEGRAL OF THIS WAVEFORM WITH A CONTINUOUS SINE WAVE IS ZERO

FIGURE 6-2
CORRELATION OF THE 4 SEGMENT (+ - - +)
ENCODED WAVEFORM WITH ITSELF



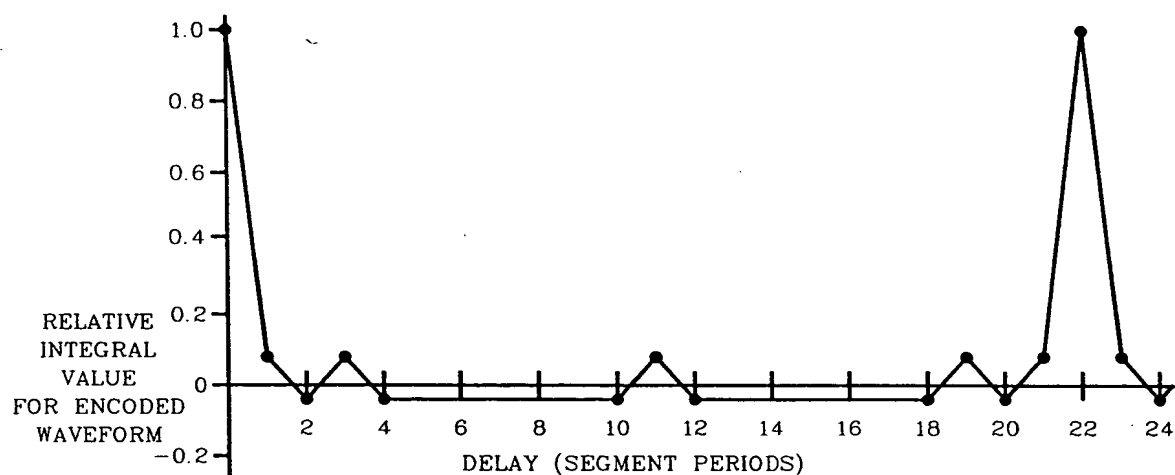
NOTE: THE INTEGRAL OF THIS WAVEFORM WITH A CONTINUOUS SINE WAVE IS 0.0526

FIGURE 6-3
 CORRELATION OF THE 19 SEGMENT
 (++++--++--++-----+-+--)
 ENCODED WAVEFORM WITH ITSELF



NOTE: THE INTEGRAL OF THIS WAVEFORM WITH A CONTINUOUS SINE WAVE IS -0.1

FIGURE 6-4
CORRELATION OF THE 20 SEGMENT
(+ - - - + + - - + - - + - + + - + - + -)
ENCODED WAVEFORM WITH ITSELF



NOTE: THE INTEGRAL OF THIS WAVEFORM WITH A CONTINUOUS SINE WAVE IS ZERO

FIGURE 6-5
CORRELATION OF THE 22 SEGMENT
(++++-----+---+---++++--++)
ENCODED WAVEFORM WITH ITSELF

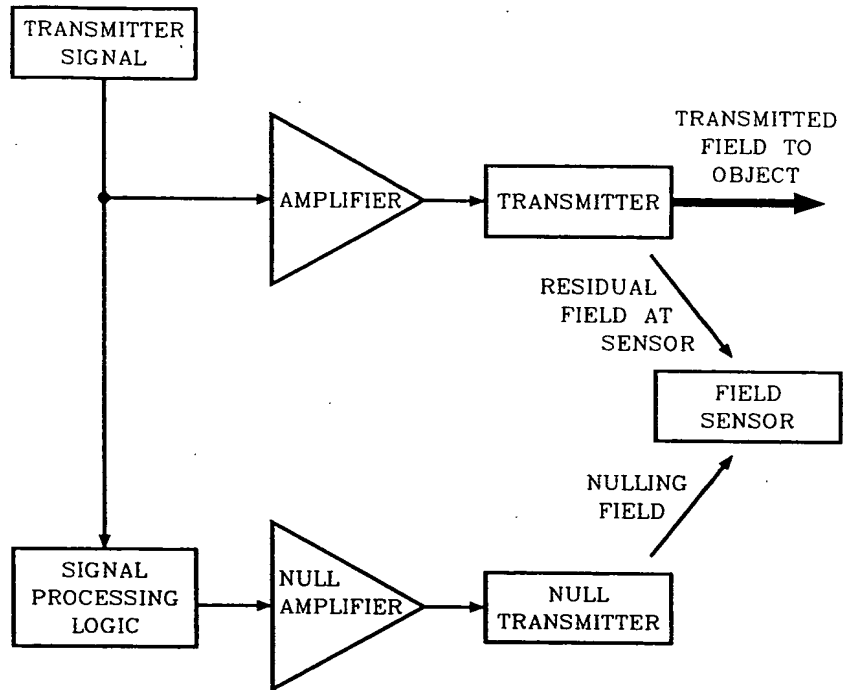


FIGURE 7-1
LOCAL MAGNETIC FIELD GENERATION
FOR RESIDUAL FIELD CANCELLATION